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AJIC brief reports

Device-specific rates of needlestick injury at a large military teaching hospital

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The device-specific needlestick injury (NSI) rate provides a means of comparing rates of injury between work sites and institutions over time. We performed a retrospective study of intravenous and percutaneous injection NSI at a large military teaching hospital using electronic purchase records and occupational NSI exposure forms to define action levels for process improvements. A rate of 2.25 NSI per 100,000 intravenous needles and 2.21 NSI per 100,000 percutaneous needles was found. (Am J Infect Control 2008;36:750-2.)

The device-specific needlestick injury (NSI) rate is a method of quantifying risk of needle injury in terms of a denominator that accounts for inherent differences in exposure risks between populations under study. Device-specific NSI provides a means of comparing rates of injury between work sites and institutions over time. Rates quoted in the literature for various devices vary significantly, ranging from 0.9 to 67.7 NSI per 100,000 devices purchased or used[1-5] depending on context, although most studies find rates of approximately 10 NSI per 100,000 devices.

The study site was a large, 260-bed military teaching hospital in Washington, DC, and, as such, its crude NSI rates reflect the risks posed across hospital and teaching departments[1,3] to medical residents,[6] nurses,[7] medical staff, and other health care workers.[8] Hospital infection control staff collect information on NSI reported within the facility using a standard exposure record that identifies the implicated device. Centralized records of needle devices purchased for use throughout the hospital are also available. These data have not previously been used for calculating rates of NSI by device. The objectives of this retrospective study were to utilize these data sources to determine crude device-specific rates of NSI and to employ bootstrapping to overcome limitations of incomplete data to define device-specific NSI action rates, above which implementation of process improvement measures might be considered.

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METHODS

Following review by the hospital's Institutional Review Board, all exposure records generated at the facility between January 2004 and March 2005 were reviewed by an investigator to identify cases of NSI for study inclusion, abstracting the date of the injury and the specific type of needle device implicated. Needle devices were categorized into 3 types: intravenous (IV) needles, percutaneous (PC) injection needles, and other. Type was listed as unknown when the exposure records were not explicit in stating the specific implicated device.

To reflect a 6-month lag time in inventory resupply, records of needle devices purchased for use at the facility between July 2004 and September 2005 were obtained from the Department of Logistics automated purchasing system. Needle devices identified in purchase records were then categorized by investigators as either IV needles, PC needles, or other.

Total NSI and purchases by device type were determined by month and year, and totaled by quarter to produce summary statistics, and by month to populate

the production of bootstrapped confidence intervals. Individual monthly unknown NSI were distributed in bootstrapping in proportion to individual monthly percentages of PC and IV to total known NSI. During bootstrapping, individual monthly numbers of NSI and purchase volumes were repetitively sampled with replacement. Results of 3000 consecutive random samples of monthly NSI and purchase records were summed in consecutive triplets to form a set of 1000 bootstrapped quarterly rates for 95% confidence interval (CI) generation. Crude mean quarterly rates were calculated, and CIs were obtained from the binomial distribution.

RESULTS

There were 56 NSI records identified during the period January 1, 2004, through March 30, 2005. Of these, 11 NSI records did not identify the type of implicated device, whereas 12 records identified the device as a non-IV, non-PC needle.

The IV and PC purchase records identified during the purchase period included a variety of makes and brands, including some safety-engineered devices purchased during their adoption across different hospital wards during the study period. There was significant quarterly variation in the number of purchased needle products, as shown in Table 1.

There were a total of 3 IV NSI and 30 PC NSI reported during the NSI record period, and there were a total of 133,050 IV needles and 1,358,300 PC needles purchased during the purchase record period, corresponding to a crude mean rate of 2.25/100,000 NSI for IV needles purchased and 2.21/100,000 NSI for PC needles purchased. Bootstrapping simulations yielded a predicted mean rate of 3.09/100,000 NSI for IV and 4.40/100,000 for PC needles purchased. 95% CIs are shown in Table 2.

Table 1. Needle purchases and NSI by type of needle device

	Total purchases		Total NSI	
Year-Quarter	IV	PC	IV	PC
2004-Q1			0	8
2004-Q2			2	3
2004-Q3	23,400	196,040	0	7
2004-Q4	36,500	201,000	0	4
2005-Q1	31,500	286,060	1	8
2005-Q2	14,700	364,600		
2005-Q3	26,950	310,600		
Total	133,050	1,358,300	3	30
Quarterly mean	26,610	271,660	0.6	6

NSI, needlestick injury; *IV*, intravenous, *PC*, percutaneous.

Table 2. Crude mean rates of device-specific NSI observed by device type and predicted by simple bootstrapping

	IV		PC	
	Rate/100,000	95% CI	Rate/100,000	95% CI
Crude	2.25	0.46-6.59	2.21	1.49-3.15
Predicted	3.09	0.00-11.2	4.40	1.90-8.87

IV, Intravenous; *PC*, percutaneous; *CI*, confidence interval; *NSI*, needlestick. injury.

DISCUSSION

This study found that the device-specific rates of NSI at this military teaching hospital were comparable with or better than those of other institutions. Both the crude and predicted rates of NSI for IV and PC needles were approximately 2 to 4 per 100,000 devices purchased. Based on the results of bootstrapped CIs and the expectation of random variation in quarterly rates, we believe a quarterly NSI action rate of 11 per 100,000 for IV and 9 per 100,000 for PC needles should be employed for implementation of process improvements.

This study has a number of limitations that require the results to be interpreted in context. The study was conducted during a period in which safety-engineered devices were increasingly in use throughout the facility. Differential underreporting of NSI following the introduction of safety-engineered devices has been reported to vary by occupation and training level, although decreases in rates overall likely reflect decreased risk.[9] One prospective study employing methods similar to this study found that the device-specific rate of NSI for PC needles decreased nonsignificantly from 16.9 to 13.9 per 100,000 devices when staff received standard training in the use of these devices, with further reductions to 6 per 100,000 devices with additional training.[5] To our knowledge, no such specialized training occurred during our study period.

The use of device-specific NSI rates implies that NSI is a random process marked by a probability of failure (''the risk of injury'') per event and that each use of a device exposes the user to a risk of NSI governed by an underlying binomial process independent of operator characteristics and previous failure. In practice, operator experience will cause risk to vary from this idealized process.[4]

In defining device-specific NSI action rates to guide process improvements, the use of observational data must include CIs to account for expected random variation. This study confirms that bootstrapping is a useful technique for producing CIs from incomplete and limited observational data,[10] providing an upper limit

with high specificity above which implementation of process improvement measures might be considered.

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